

# PNEUMATIC APPLICATOR FOR UNIFORM DISTRIBUTION OF DRY FERTILIZER ON SMALL PLOTS<sup>1</sup>

G. E. VARVEL AND R. K. SEVERSON<sup>2</sup>

## Abstract

Uniform distribution of dry fertilizer materials on small plot areas has been a problem for many years because most of the equipment has been developed for field application. Recent developments of pneumatic herbicide and fertilizer application equipment have been made which allow uniform distribution of these materials over various size areas. These developments made components available which were used to construct a small-plot applicator to broadcast or inject dry fertilizer. This applicator accurately and consistently metered and distributed three fertilizer materials which varied in particle size. The use of air to distribute the fertilizer also permits various applicator widths with the same machine.

**Additional index words:** Air fertilizer spreader, Fertilizer size (aggregate), Fertilizer rates.

UNIFORM application of dry fertilizer materials has been a major problem for farmers and researchers alike for many years. Jensen and Pesek (2, 3, 4) developed equations to theoretically estimate the effects of nonuniform fertilizer application on crop yield. Their discussions centered on problems in the field resulting from nonuniform particle size and fractional segregation of fertilizer materials in bulk spreaders. These problems also occur on field research plots because few pieces of small-plot equipment have been developed which can accurately meter and distribute dry fertilizer materials. Nonuniform application does cause problems as was shown by Lutz et al. (1), who found significant differences in crop yields within spread patterns on most soils they investigated. These problems could be reduced if the fertilizer applicator would accurately meter and uniformly distribute dry fertilizer materials of various particle sizes.

Recent developments in the manufacture of pneumatic commercial herbicide and fertilizer application equipment have been made which have reduced the problem of nonuniform distribution. The mechanics of this equipment are shown in Fig. 1. Components from this equipment were used to construct a small-plot dry fertilizer applicator that could be used to broadcast or inject (band) various size fertilizer materials accurately and consistently. The applicator and its construction are described below.

## Components

The unit (Fig. 1) consisted of a fertilizer hopper, removable grooved roller feed mechanism, venturis, hydraulically driven fan, air manifold with outlets connected to venturis with plastic tubing, flextube connecting fan to air manifold, 10 position gearbox for setting rates, and flexible tubing connecting venturis to either a deflector for broadcast application or a knife for band application. The removable grooved

roller feed mechanism, venturis, fan, air manifold, and deflectors were purchased from a local distributor for Valmar Manufacturing Limited of Canada<sup>3</sup>. All the other components were assembled or purchased from other sources.

The applicator was developed to fit on a small-plot anhydrous ammonia applicator (2.44 m wide) used extensively in our research program. The unit was ground driven by a gauge wheel which controlled the depth of application for either the anhydrous ammonia or the dry fertilizer bands.

The use of air to transport fertilizer material to the broadcast deflector or injection knife permits various unit widths. Our deflectors and knife spacings were 0.31 m, but other spacings (0.38, 0.46, and 0.61 m) were tried and distribution patterns were observed. In all cases, the patterns appeared quite uniform and no differences between patterns were observed. Also, no differences were observed in delivery time between any of the tubes (outlets) at all of the spacings tested.

## Performance and Evaluation

The effectiveness of the applicator in accurately and consistently metering and distributing three fertilizer materials with various particle size distributions and particle densities is indicated in Table 1. The materials used were urea, triple super phosphate (TSP), and a coganulated urea ammonium phosphate (UAP). These

Table 1. Distribution characteristics of the pneumatic fertilizer applicator as influenced by three fertilizer materials at different settings.

Material	Material distribution characteristics/30.5 m		
	Setting	Weight/outlet†	CV‡
Urea		g	
	1	64	2.0
	2	107	2.3
Triple super phosphate	3	214	2.3
	1	104	3.4
	2	173	3.3
Urea ammonium phosphate	3	349	4.0
	1	60	2.1
	2	108	2.8
	3	221	2.7

† Overall mean of four runs.

‡ CV = Coefficient of variation.

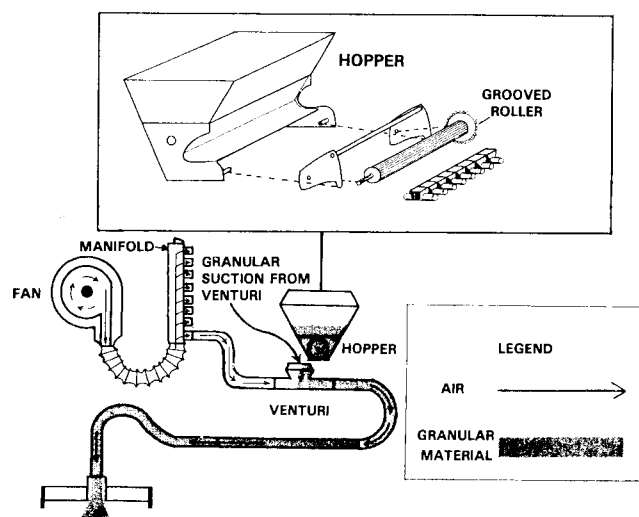


Fig. 1. Diagram of the air fertilizer distribution system.

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<sup>2</sup> Former associate professor (now soil scientist, ARS-USDA, Lincoln, NE) and assistant scientist, Northwest Exp. Stn., Univ. of Minnesota, Crookston, MN 56716.

<sup>3</sup> Elie, Manitoba. Mention of trade name does not express or imply endorsement of this product by the Univ. of Minnesota. The address is supplied for the reader's information.

materials varied from a relatively uniform particle size (urea) to a mixture of irregular crystals of various sizes (UAP). The material was collected and weighed from each outlet after applicator runs of 30.5 m at three different settings with each of the fertilizers. Four runs were made at each setting to determine the consistency of the applicator. The overall mean and the coefficient of variation (CV) for the four runs for each setting are shown in Table 1. In all cases, the applicator proved accurate and consistent for the materials tested.

## A MODIFIED FLAIL MOWER FOR HARVESTING FORAGE RESEARCH PLOTS<sup>1</sup>

G. L. BARNES, G. L. McLAUGHLIN, W. D. FOSTER, AND  
W. E. MCMURPHY<sup>2</sup>

### Abstract

Harvesting forage plots for yield determination usually involves separate cutting and collection operations. A standard commercial hammer knife (flail) mower was modified by an addition of an Al collecting box for recovery of cut forage from individual plots. A top-hinged rear door facilitated easy removal of harvests onto small tared tarpaulins for subsequent weighing. The modified unit proved to be effective for excellent recovery of cut alfalfa (*Medicago sativa* L.) forage.

**Additional index words:** Yield determination *Medicago sativa* L.

**H**ARVESTING forage samples from field plots is usually a tedious process involving separate cutting and collecting operations. This involves use of several pieces of equipment, may involve much hand labor and imposes a risk of losing variable amounts of plot material. A prototype collector consisting of a wooden top-opening box attached behind a flail mower was constructed and used to collect sorghum [*Sorghum bicolor* (L.) Moench] samples. A flail mower was selected because this equipment finely chops plant material into small, packable, easily handled samples. Removing samples through the top was difficult and inefficient. Another unit with an Al collecting box with a rear-opening door was designed and field tested for collecting alfalfa (*Medicago sativa* L.) forage samples.

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<sup>2</sup> Professor, Dep. of Plant Pathology; Mgr. Farm Res. Lab., Dep. of Agricultural Engineering; senior agriculturist, Dep. of Plant Pathology; professor, Dep. of Agronomy, Oklahoma State University, Stillwater, OK 74078.

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Construction details and potential usefulness of the equipment is discussed.

### Materials and Methods

A Mott T-38 hammerknife mower, equipped with an 5965.6J s<sup>-1</sup> (8 H.P.) Briggs and Stratton drive engine, was purchased from the Mott Corporation, La Grange, IL 60525. The mower is 1.22 m (48 inches) wide and cuts a 0.965 m (38 inches) swath (Fig. 1A). An Al sheet metal collection box with a rear-opening door hinged at the top was built and attached to the mower (Fig. 1B). A drive belt and a clutch handle were installed on the left side of the box for engaging or disengaging the engine drive to the mower drive shaft. Hydraulic lift rods were welded to the front of the mower to allow the operator to keep the unit elevated to desired cutting height and also for lifting to a higher position during transport (Fig. 1C). When a desired sample of alfalfa was obtained, the box was lifted slightly to allow removal of the sample, with a flat bladed shovel, onto a small tared tarpaulin. An interior view of the unit is presented in Fig. 1D. Construction details for the box are presented in Fig. 1E. An International Harvester Cub tractor was attached to the mower drawbar to pull the unit. Similar, or even smaller, hydraulic lift equipped tractors can be used for this purpose. The tractor and attached collection unit can be easily hauled on a trailer.

In our alfalfa research plots, the mower was used to cut 0.965 m (38 inches) swaths down the centers of 3.04 × 6.08 m (10 × 20 ft.) plots. Samples can be cut and collected quickly and completely in a one step operation.

For overall field clean-up purposes after sampling from plot centers, another specialized unit such as designed and used by Caddel et al. (2) might be used behind a forage plot harvester similar to the one described by Buker (1).

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